

Note(1) Pin number starts from Right side

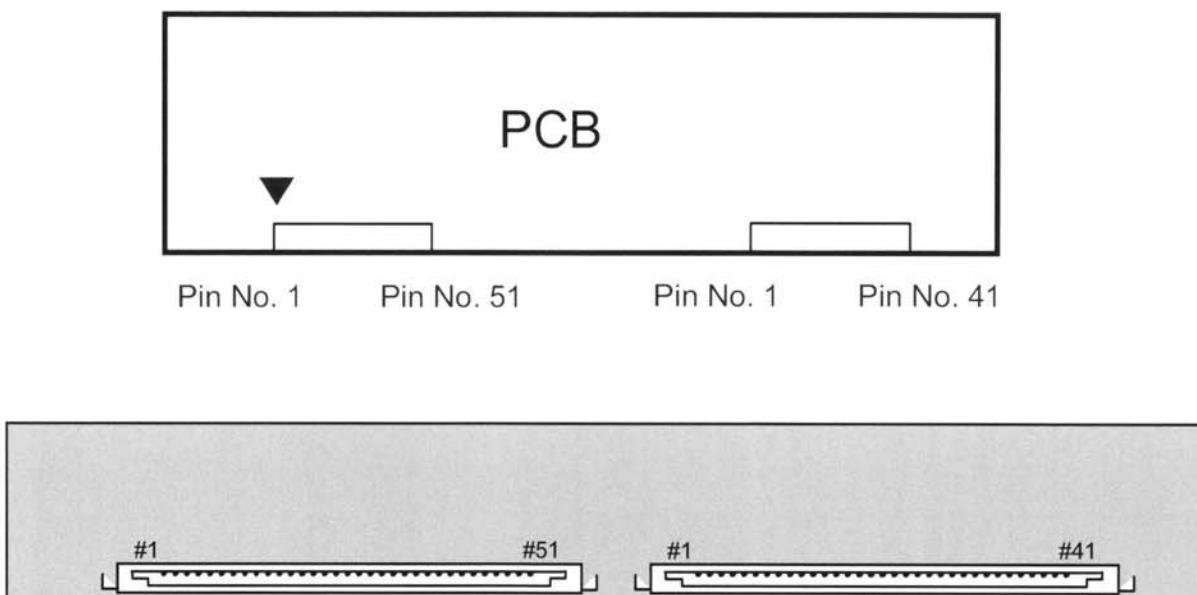


Fig. Connector diagram

- a. All GND pins should be connected together and also be connected to the LCD's metal chassis.
- b. All power input pins should be connected together.
- c. All NC pins should be separated from other signal or power.

5.2. Balance Board

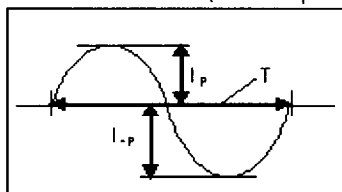
5.2.1 Recommended Operation Condition

Item	Symbol	Recommendation			Unit	Note	Remark
		Min.	Typ.	Max.			
Inverter Frequency	F_{OP}	53	55	57	kHz		Switching Frequency
Dimming Frequency	F_{DIM}	150	160	170	Hz		
Dim Duty Ratio	D_{PWM}	20	-	100	%		Bright Control
Striking Voltage	HV_{STRIKE}	4200	-	-	Vrms	(1)	

Note

Asymmetric ratio of Total Input Current must be less than 10 % ($|I_P - I_{-P}| / (I_{rms@T} < 0.1)$)

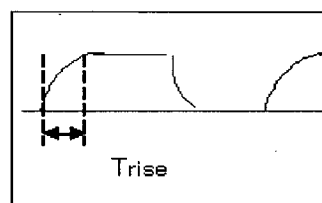
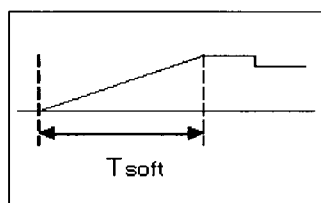
Crest factor must be from 90 % to 110 % ($0.9 < I_P / I_{rms@T/2 \times \sqrt{2}} < 1.1$)



(1) Striking Voltage(HV_{STRIKE}) based on CCFL spec. for ambient temperature.

Soft rising time must be

- at starting time $T_{soft} > 300\text{msec}$
- at PWM dimming condition $Trise < 100\text{usec}$





5.2.2 Balance Board Input Pin Configuration

1. HV Input Connector : MD51SU-2P-13V(Hirose)

PIN NO.	SYMBOL	REMARK
1	HV1	Power Supply for CCFL
2	HV2	Power Supply for CCFL

2. Feed Back Interface : KN30-7P-1.25H(Hirose)

PIN NO.	SYMBOL	REMARK
1	Vcc	12V
2	FB	Feed Back
3	GND	GND
4,5,6,7	LD	Lamp Detection

3. HV Input Connector : BM03-XASS-TF(LF)(SN)(JST)

PIN NO.	SYMBOL	REMARK
1	HV1	Power Supply for CCFL
2	NC	NC
3	HV1	Power Supply for CCFL

4. HV Input Connector : BM04B-XASS-TF(LF)(SN)(JST)

PIN NO.	SYMBOL	REMARK
1	HV2	Power Supply for CCFL
2	NC	NC
3	HV2	Power Supply for CCFL
4	NC	NC



5. Left Right Interface Connector : KN30-10P-1.25H (Hirose)

PIN NO.		SYMBOL	REMARK
Left	Right		
10,9	1,2	GND	Ground
8,7	3,4	VCC	12V
6,5,	5,6	PROT	Protect Interface
4,3,2,1	7,8,9,10	LOOP	JIN Coil Loop

5.2.3 Feedback I/O Specification

ITEM		SYMBOL	Recommendation			UNIT	REMARKS
			Min.	Typ.	Max.		
Supply Voltage		V_{CC}	11	12	15	V	Lamp
Input current Of V_{CC}		I_{OC}	-	-	20	mA	at Recommended Load Condition
Lamp Detection	High (Normal)	V_{LD}	$V_{CC}-1$	-	-	V	@ $V_{CC} = 12 [V]$
	Low (LD)		-	-	1		

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5.3 LVDS Interface

	LVDS pin	Odd Data	Even Data
TxOUT/RxIN0	TxIN/RxOUT0	R4	R4
	TxIN/RxOUT1	R5	R5
	TxIN/RxOUT2	R6	R6
	TxIN/RxOUT3	R7	R7
	TxIN/RxOUT4	R8	R8
	TxIN/RxOUT6	R9	R9
	TxIN/RxOUT7	G4	G4
TxOUT/RxIN1	TxIN/RxOUT8	G5	G5
	TxIN/RxOUT9	G6	G6
	TxIN/RxOUT12	G7	G7
	TxIN/RxOUT13	G8	G8
	TxIN/RxOUT14	G9	G9
	TxIN/RxOUT15	B4	B4
	TxIN/RxOUT18	B5	B5
TxOUT/RxIN2	TxIN/RxOUT19	B6	B6
	TxIN/RxOUT20	B7	B7
	TxIN/RxOUT21	B8	B8
	TxIN/RxOUT22	B9	B9
	TxIN/RxOUT24	HSYNC	HSYNC
	TxIN/RxOUT25	VSYNC	VSYNC
	TxIN/RxOUT26	DEN	DEN
TxOUT/RxIN3	TxIN/RxOUT27	R2	R2
	TxIN/RxOUT5	R3	R3
	TxIN/RxOUT10	G2	G2
	TxIN/RxOUT11	G3	G3
	TxIN/RxOUT16	B2	B2
	TxIN/RxOUT17	B3	B3
	TxIN/RxOUT23	RESERVED	RESERVED
TxOUT/RxIN4	TxIN/RxOUT28	R0	R0
	TxIN/RxOUT29	R1	R1
	TxIN/RxOUT30	G0	G0
	TxIN/RxOUT31	G1	G1
	TxIN/RxOUT32	B0	B0
	TxIN/RxOUT33	B1	B1
	TxIN/RxOUT34	RESERVED	RESERVED

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5.4 Input Signals, Basic Display Colors and Gray Scale of Each Color

COLOR	DISPLAY	DATA SIGNAL																								GRAY SCALE LEVEL								
		RED									GREEN									BLUE														
		R0	R1	R2	R3	R4	R5	R6	R7	R8	R9	G0	G1	G2	G3	G4	G5	G6	G7	G8	G9	B0	B1	B2	B3		B4	B5	B6	B7	B8	B9		
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-		
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	-		
	GREEN	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	-		
	CYAN	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
	RED	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-		
	MAGENTA	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	-	
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	-	
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0		
	DARK ↑	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1	
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R1020
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	↓ LIGHT	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1021
		0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1022
	RED	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1023	
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0	
	DARK ↑	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1
		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~G1020
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	↓ LIGHT	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	G1021
		0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	G1022
	GREEN	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	G1023	
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0	
	DARK ↑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	B1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	B2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B1020
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	↓ LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	B1021
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	B1022
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	B1023	

Note) Definition of Gray :

Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

Input Signal : 0 = Low level voltage, 1 = High level voltage

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6. Interface Timing

6.1 Timing Parameters (DE only mode)

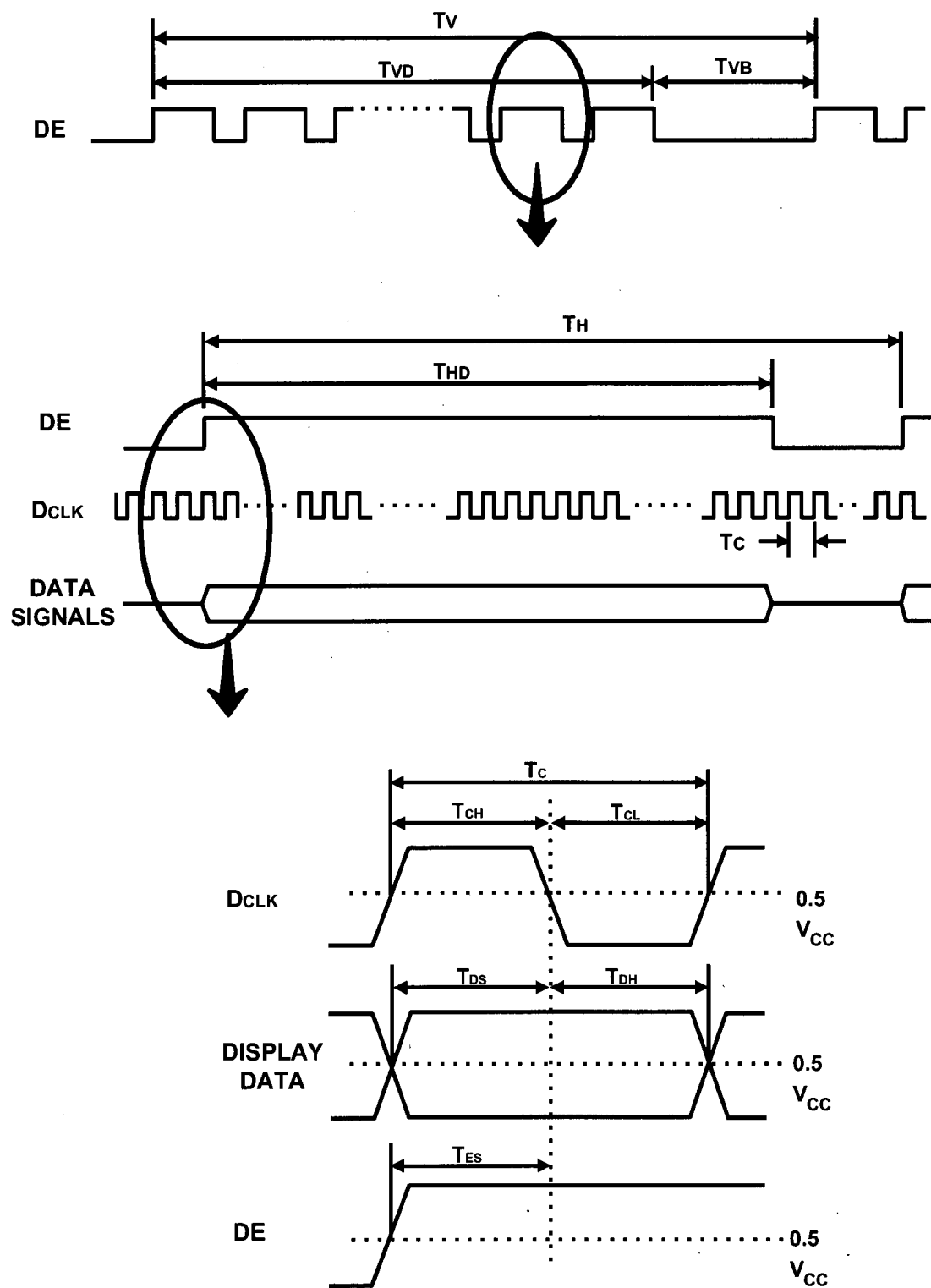
SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	Unit	NOTE
Clock	Frequency	$1/T_C$	280	297	300	MHz	-
Hsync		F_H	108	135	137	KHz	-
Vsync		F_V	92	120	123	Hz	-
Vertical Display Term	Active Display Period	T_{VD}	-	1080	-	lines	-
	Vertical Total	T_{VB}	1086	1125	1480	Lines	-
Horizontal Display Term	Active Display Period	T_{HD}	-	1920	-	clocks	-
	Horizontal Total	T_H	2056	2200	2616	clocks	-

Note) This product is DE only mode. The input of Hsync & Vsync signal does not have an effect on normal operation.

(1) Test Point : TTL control signal and CLK at LVDS Tx input terminal in system

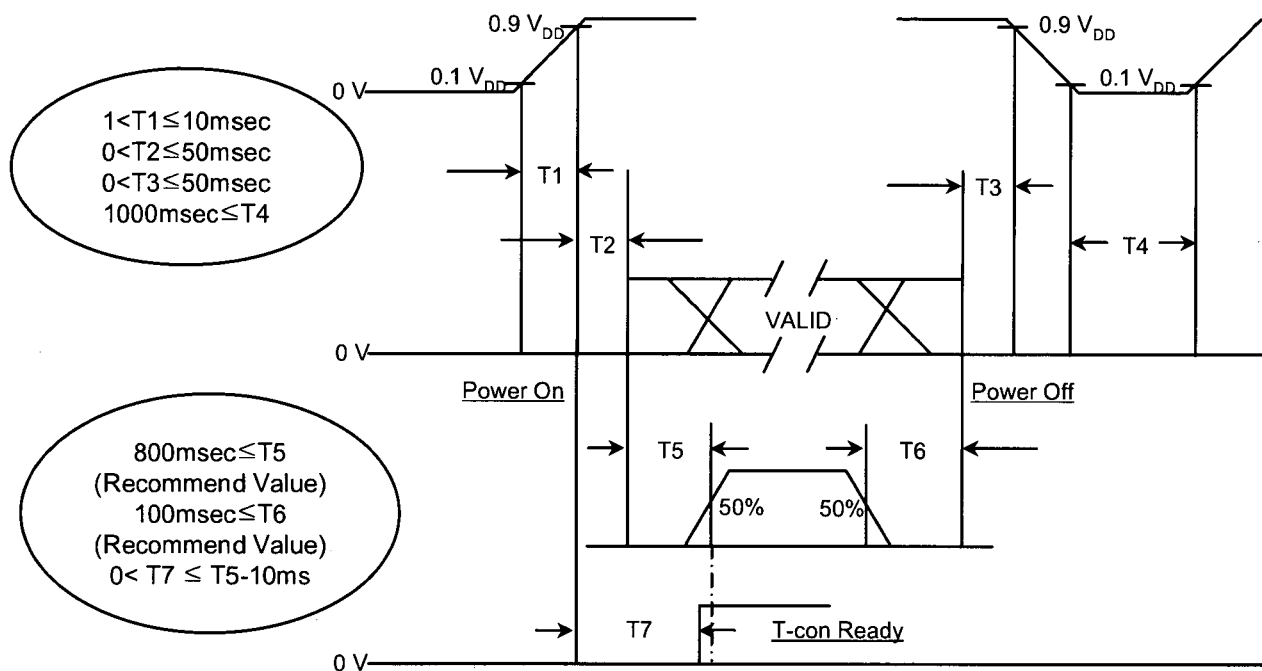
(2) Internal $V_{DD} = 3.3V$

6.2 Timing diagrams of interface signal (DE only mode)



6.3 Power ON/OFF Sequence

To prevent a latch-up or DC operation of the LCD Module, the power on/off sequence should be as the diagram below.



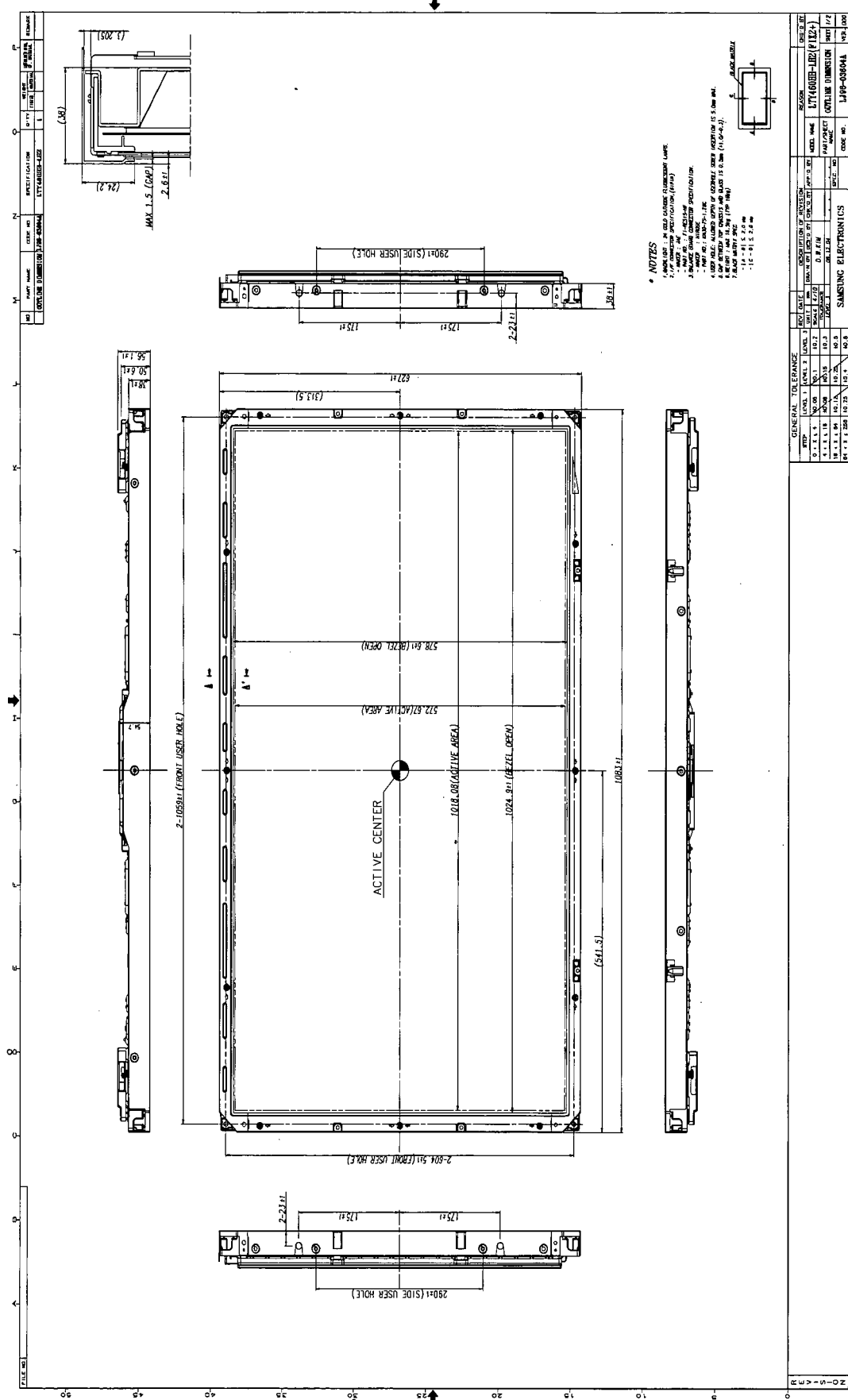
T1 : V_{DD} rising time from 10% to 90%
 T2 : The time from V_{DD} to valid data at power ON.
 T3 : The time from valid data off to V_{DD} off at power Off.
 T4 : V_{DD} off time for Windows restart
 T5 : The time from valid data to B/L enable at power ON.
 T6 : The time from valid data off to B/L disable at power Off.
 T7 : The time from Vin to T-Con Ready

[Valid Data Condition]

1. Input LVDS signals must satisfy "Interface Timing" Specification on p20.
2. LVDS Clock must keep the same frequency.
3. "Temp SEL" signal should not be changed within Tcon Reset and Tcon Ready.
4. Data signal should not input during "Fail Safe Mode".

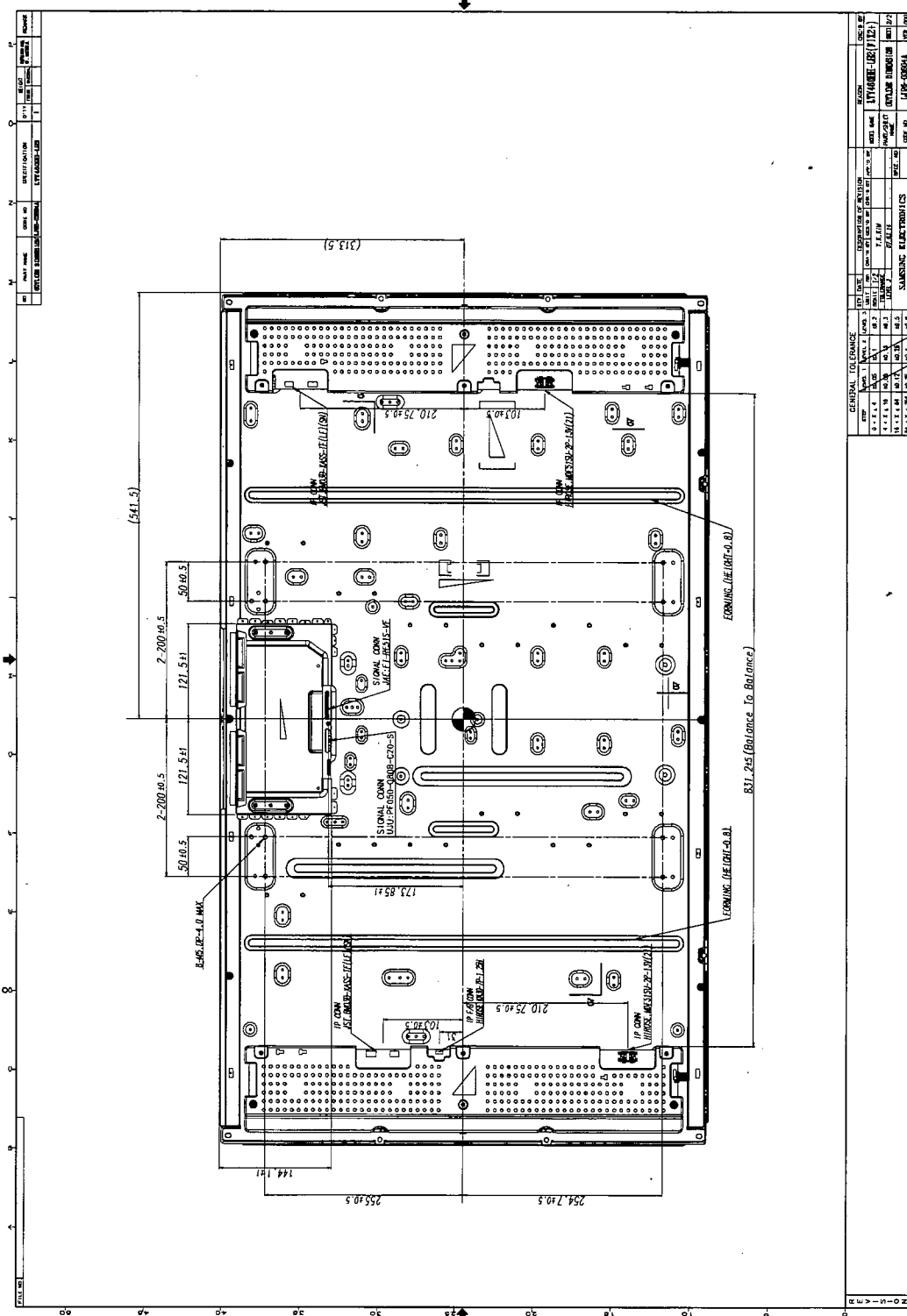
- The supply voltage of the external system for the Module input should be the same as the definition of V_{DD} .
- Apply the lamp voltage within the LCD operation range. When the back light turns on before the LCD operation or the LCD turns off before the back light turns off, the display may momentarily show abnormal screen.
- In case of V_{DD} = off level, please keep the level of input signals low or keep a high impedance.
- T4 should be measured after the Module has been fully discharged between power off and on period.
- Interface signal should not be kept at high impedance when the power is on.

7. Outline dimension (Front view)




GENERAL TOLERANCE				REV	DATE	DESCRIPTION OF REVISION	DATE	BY
STEP	LEVEL 1	LEVEL 2	LEVEL 3					
1	±0.15	±0.1	±0.05			DATE OF NEXT CHECK-UP	APP. BY	
2	±0.15	±0.1	±0.05					
3	±0.15	±0.1	±0.05					
4	±0.15	±0.1	±0.05					
5	±0.15	±0.1	±0.05					
6	±0.15	±0.1	±0.05					
7	±0.15	±0.1	±0.05					
8	±0.15	±0.1	±0.05					
9	±0.15	±0.1	±0.05					
10	±0.15	±0.1	±0.05					
11	±0.15	±0.1	±0.05					
12	±0.15	±0.1	±0.05					
13	±0.15	±0.1	±0.05					
14	±0.15	±0.1	±0.05					
15	±0.15	±0.1	±0.05					
16	±0.15	±0.1	±0.05					
17	±0.15	±0.1	±0.05					
18	±0.15	±0.1	±0.05					
19	±0.15	±0.1	±0.05					
20	±0.15	±0.1	±0.05					
21	±0.15	±0.1	±0.05					
22	±0.15	±0.1	±0.05					
23	±0.15	±0.1	±0.05					
24	±0.15	±0.1	±0.05					
25	±0.15	±0.1	±0.05					
26	±0.15	±0.1	±0.05					
27	±0.15	±0.1	±0.05					
28	±0.15	±0.1	±0.05					
29	±0.15	±0.1	±0.05					
30	±0.15	±0.1	±0.05					
31	±0.15	±0.1	±0.05					
32	±0.15	±0.1	±0.05					
33	±0.15	±0.1	±0.05					
34	±0.15	±0.1	±0.05					
35	±0.15	±0.1	±0.05					
36	±0.15	±0.1	±0.05					
37	±0.15	±0.1	±0.05					
38	±0.15	±0.1	±0.05					
39	±0.15	±0.1	±0.05					
40	±0.15	±0.1	±0.05					
41	±0.15	±0.1	±0.05					
42	±0.15	±0.1	±0.05					
43	±0.15	±0.1	±0.05					
44	±0.15	±0.1	±0.05					
45	±0.15	±0.1	±0.05					
46	±0.15	±0.1	±0.05					
47	±0.15	±0.1	±0.05					
48	±0.15	±0.1	±0.05					
49	±0.15	±0.1	±0.05					
50	±0.15	±0.1	±0.05					
51	±0.15	±0.1	±0.05					
52	±0.15	±0.1	±0.05					
53	±0.15	±0.1	±0.05					
54	±0.15	±0.1	±0.05					
55	±0.15	±0.1	±0.05					

Outline dimension (Rear View)



GENERAL TOLERANCE			LOT DATE	DESCRIPTION OF MATERIAL	REASON	COSTLY BY
STEP	LEVEL	LOT	DATE	DESCRIPTION OF MATERIAL	REASON	COSTLY BY
1	1	1000	10/10/10	1000	10/10/10	1000
2	2	1000	10/10/10	1000	10/10/10	1000
3	3	1000	10/10/10	1000	10/10/10	1000
4	4	1000	10/10/10	1000	10/10/10	1000
5	5	1000	10/10/10	1000	10/10/10	1000
6	6	1000	10/10/10	1000	10/10/10	1000
7	7	1000	10/10/10	1000	10/10/10	1000
8	8	1000	10/10/10	1000	10/10/10	1000
9	9	1000	10/10/10	1000	10/10/10	1000
10	10	1000	10/10/10	1000	10/10/10	1000
11	11	1000	10/10/10	1000	10/10/10	1000
12	12	1000	10/10/10	1000	10/10/10	1000
13	13	1000	10/10/10	1000	10/10/10	1000
14	14	1000	10/10/10	1000	10/10/10	1000
15	15	1000	10/10/10	1000	10/10/10	1000
16	16	1000	10/10/10	1000	10/10/10	1000
17	17	1000	10/10/10	1000	10/10/10	1000
18	18	1000	10/10/10	1000	10/10/10	1000
19	19	1000	10/10/10	1000	10/10/10	1000
20	20	1000	10/10/10	1000	10/10/10	1000
21	21	1000	10/10/10	1000	10/10/10	1000
22	22	1000	10/10/10	1000	10/10/10	1000
23	23	1000	10/10/10	1000	10/10/10	1000
24	24	1000	10/10/10	1000	10/10/10	1000
25	25	1000	10/10/10	1000	10/10/10	1000
26	26	1000	10/10/10	1000	10/10/10	1000
27	27	1000	10/10/10	1000	10/10/10	1000
28	28	1000	10/10/10	1000	10/10/10	1000
29	29	1000	10/10/10	1000	10/10/10	1000
30	30	1000	10/10/10	1000	10/10/10	1000
31	31	1000	10/10/10	1000	10/10/10	1000
32	32	1000	10/10/10	1000	10/10/10	1000
33	33	1000	10/10/10	1000	10/10/10	1000
34	34	1000	10/10/10	1000	10/10/10	1000
35	35	1000	10/10/10	1000	10/10/10	1000
36	36	1000	10/10/10	1000	10/10/10	1000
37	37	1000	10/10/10	1000	10/10/10	1000
38	38	1000	10/10/10	1000	10/10/10	1000
39	39	1000	10/10/10	1000	10/10/10	1000
40	40	1000	10/10/10	1000	10/10/10	1000
41	41	1000	10/10/10	1000	10/10/10	1000
42	42	1000	10/10/10	1000	10/10/10	1000
43	43	1000	10/10/10	1000	10/10/10	1000
44	44	1000	10/10/10	1000	10/10/10	1000
45	45	1000	10/10/10	1000	10/10/10	1000
46	46	1000	10/10/10	1000	10/10/10	1000
47	47	1000	10/10/10	1000	10/10/10	1000
48	48	1000	10/10/10	1000	10/10/10	1000
49	49	1000	10/10/10	1000	10/10/10	1000
50	50	1000	10/10/10	1000	10/10/10	1000
51	51	1000	10/10/10	1000	10/10/10	1000
52	52	1000	10/10/10	1000	10/10/10	1000
53	53	1000	10/10/10	1000	10/10/10	1000
54	54	1000	10/10/10	1000	10/10/10	1000
55	55	1000	10/10/10	1000	10/10/10	1000
56	56	1000	10/10/10	1000	10/10/10	1000
57	57	1000	10/10/10	1000	10/10/10	1000
58	58	1000	10/10/10	1000	10/10/10	1000
59	59	1000	10/10/10	1000	10/10/10	1000
60	60	1000	10/10/10	1000	10/10/10	1000
61	61	1000	10/10/10	1000	10/10/10	1000
62	62	1000	10/10/10	1000	10/10/10	1000
63	63	1000	10/10/10	1000	10/10/10	1000
64	64	1000	10/10/10	1000	10/10/10	1000
65	65	1000	10/10/10	1000	10/10/10	1000
66	66	1000	10/10/10	1000	10/10/10	1000
67	67	1000	10/10/10	1000	10/10/10	1000
68	68	1000	10/10/10	1000	10/10/10	1000
69	69	1000	10/10/10	1000	10/10/10	1000
70	70	1000	10/10/10	1000	10/10/10	1000
71	71	1000	10/10/10	1000	10/10/10	1000
72	72	1000	10/10/10	1000	10/10/10	1000
73	73	1000	10/10/10	1000	10/10/10	1000
74	74	1000	10/10/10	1000	10/10/10	1000
75	75	1000	10/10/10	1000	10/10/10	1000
76	76	1000	10/10/10	1000	10/10/10	1000
77	77	1000	10/10/10	1000	10/10/10	1000
78	78	1000	10/10/10	1000	10/10/10	1000
79	79	1000	10/10/10	1000	10/10/10	1000
80	80	1000	10/10/10	1000	10/10/10	1000
81	81	1000	10/10/10	1000	10/10/10	1000
82	82	1000	10/10/10	1000	10/10/10	1000
83	83	1000	10/10/10	1000	10/10/10	1000
84	84	1000	10/10/10	1000	10/10/10	1000
85	85	1000	10/10/10	1000	10/10/10	1000
86	86	1000	10/10/10	1000	10/10/10	1000
87	87	1000	10/10/10	1000	10/10/10	1000
88	88	1000	10/10/10	1000	10/10/10	1000
89	89	1000	10/10/10	1000	10/10/10	1000
90	90	1000	10/10/10	1000	10/10/10	1000
91	91	1000	10/10/10	1000	10/10/10	1000
92	92	1000	10/10/10	1000	10/10/10	1000
93	93	1000	10/10/10	1000	10/10/10	1000
94	94	1000	10/10/10	1000	10/10/10	1000
95	95	1000	10/10/10	1000	10/10/10	1000
96	96	1000	10/10/10	1000	10/10/10	1000
97	97	1000	10/10/10	1000	10/10/10	1000
98	98	1000	10/10/10	1000	10/10/10	1000
99	99	1000	10/10/10	1000	10/10/10	1000
100	100	1000	10/10/10	1000	10/10/10	1000



20-15-A-232



8. EMI Recommendation

: -3dB at CISPR22 Class B

This EMI Recommendation is recommended to be measured at SET Condition.

9. Input Spread Spectrum Specification

	Modulation Rate (Max.)	Modulation Frequency (Min.)	Modulation Frequency (Max.)
Input	±1.2%	50KHz	200Khz

10. UL Approval

MODEL

LTY[Z]460HH-LH2

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